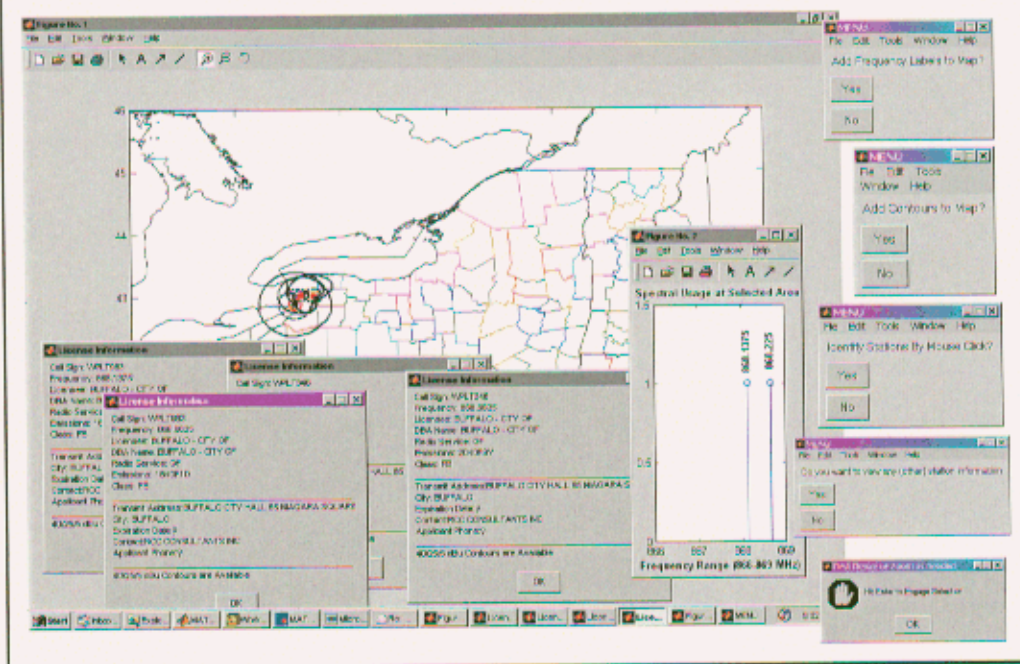


Identification of Usable Spectrum

- **FCC license data for much of the Northeast US was loaded into a custom database.**
 - Developed for SWN spectrum planning
 - Database provides integrated mapping utilities
- **RPC-approved channel allotments were loaded into the database.**
- **Generated 40, 25, and 5 dBu contours for all of the above (over 13,000 contours).**
 - Okumura-Hata w/ directional HAAT (72 radials per TIA)
 - Contours and HAAT arrays are stored and are integral to the database
 - Contours were provided with the application

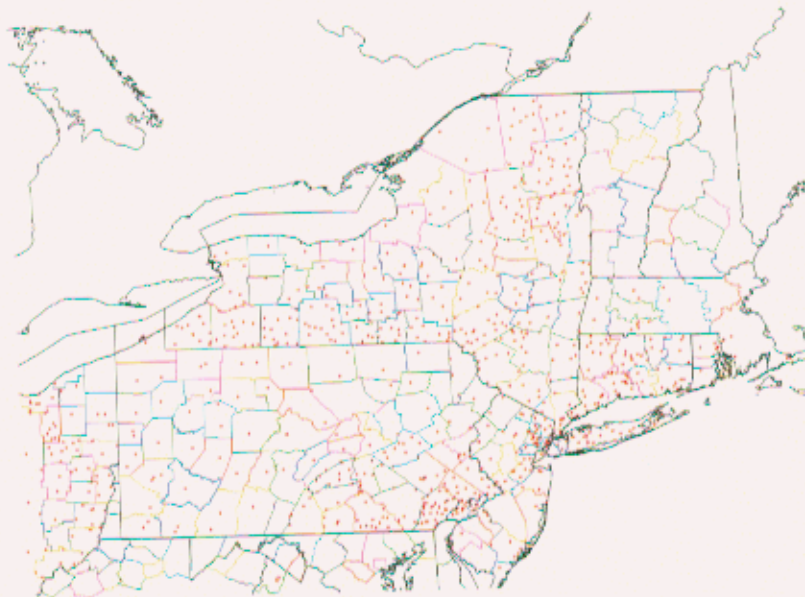
Database User Interface



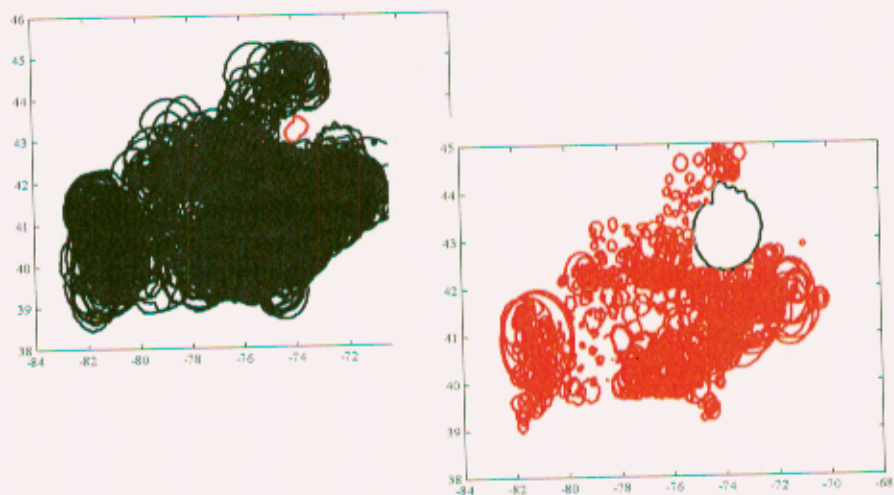
Identification of Usable Spectrum (cont.)

- Computed contours for all preliminary design sites
 - Also utilized actual antenna directivity for these sites
 - Added these to the database
- Identified NPSPAC spectral options for each site through examination of contour intersections
 - Co-channel 5 dBu to 40 dBu, & vice-versa
 - Adj-channel 25 dBu to 40 dBu, & vice-versa
- Similar process followed for 806 MHz, except site separation and DHAAT were employed as spectrum identification criteria

Database Locations for NPSPAC Search



Example of Spectral Identification Results



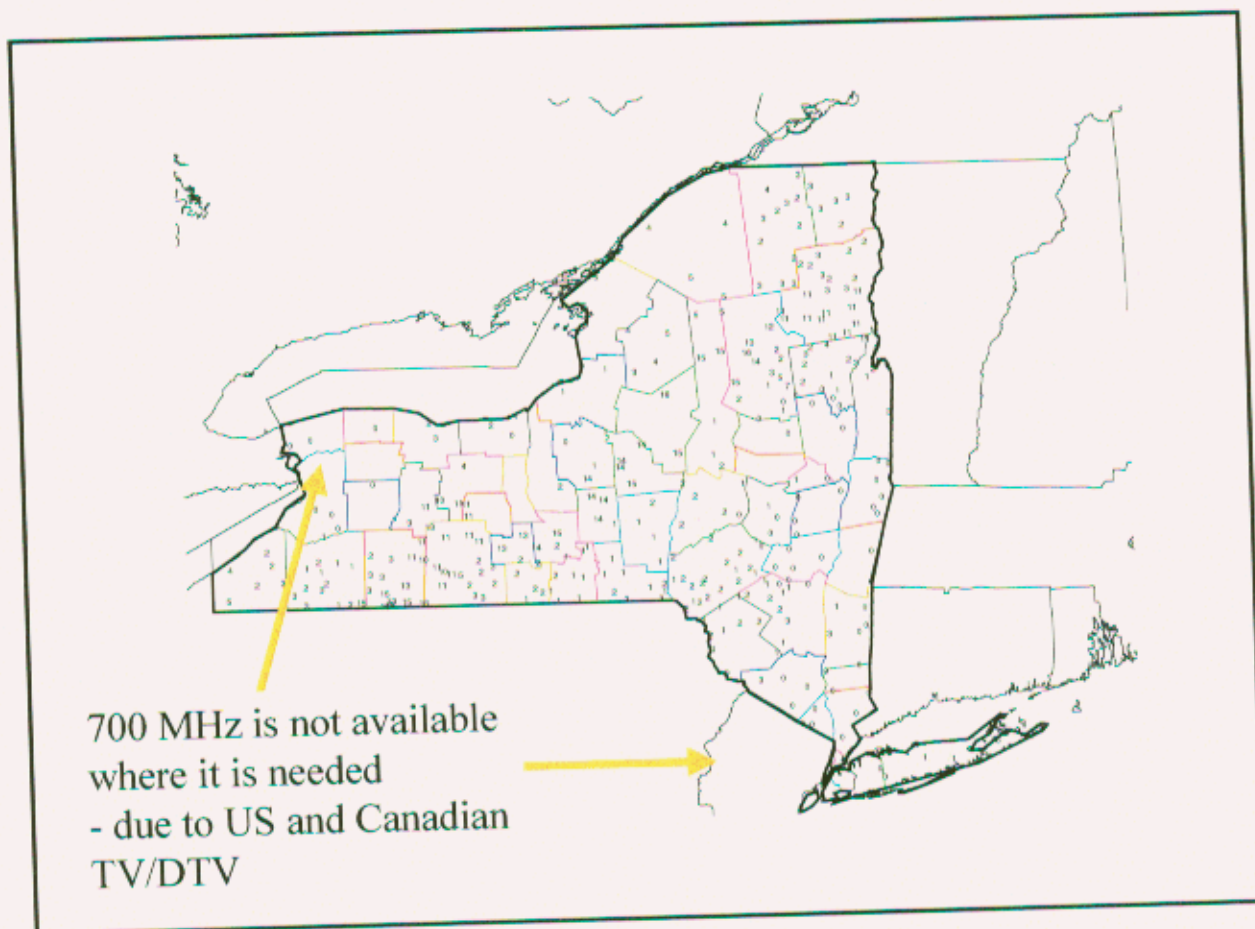


Figure I-1: Maximum Available 806 MHz Channels (w/Reuse)

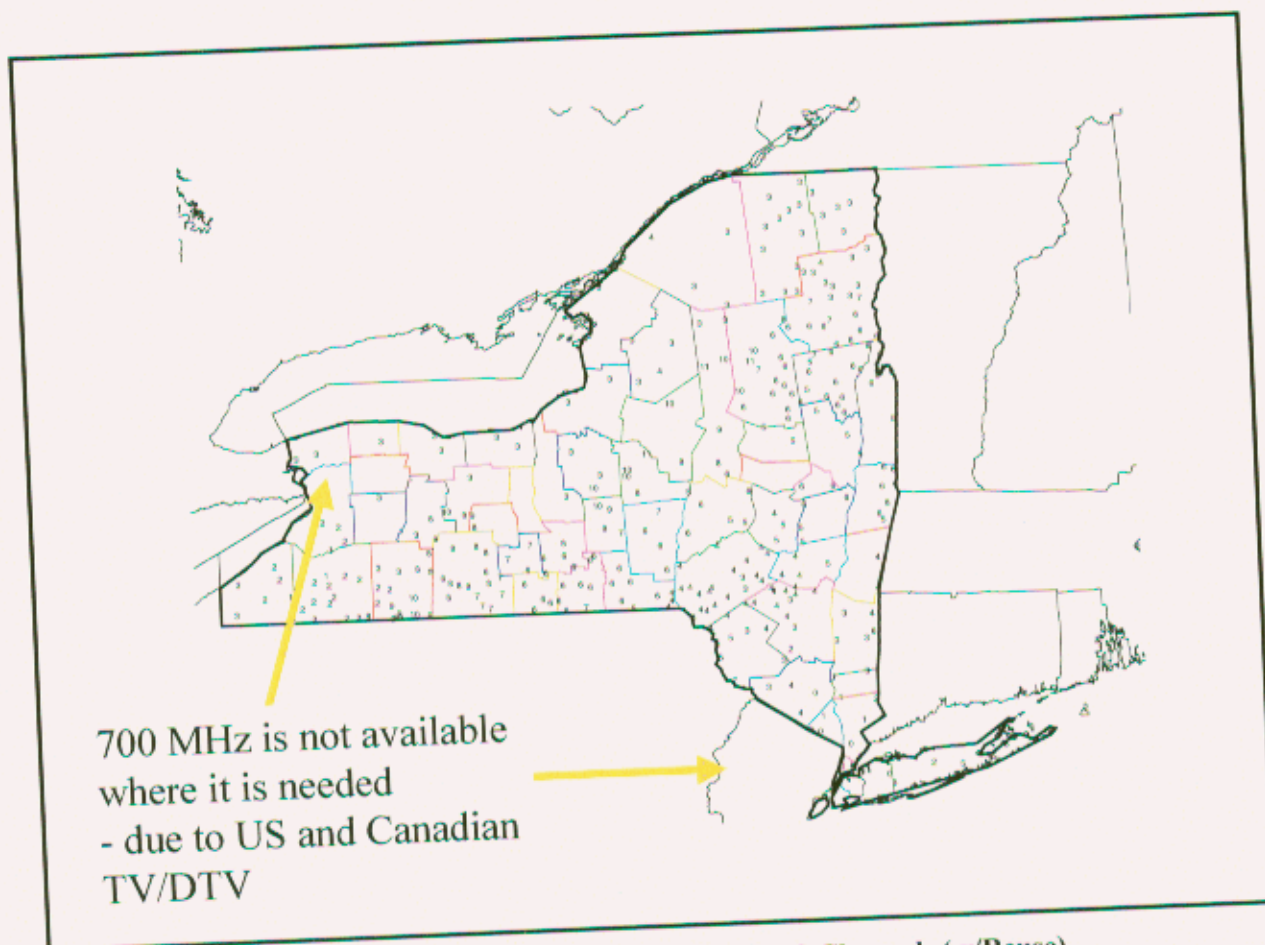
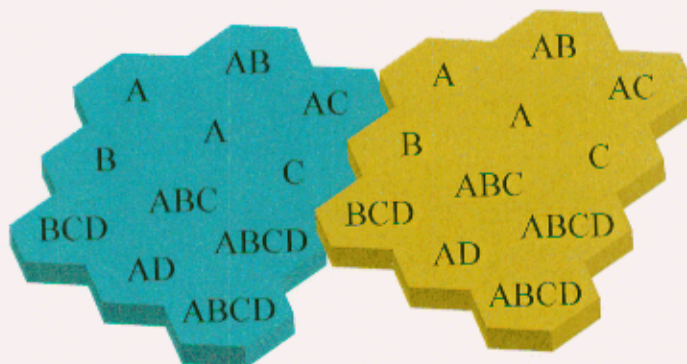


Figure I-2: Maximum Available NPSPAC Channels (w/Reuse)

J. PRESENTATION: SWN SPECTRUM/CAPACITY NEEDS

The following documents the methodology that New York State used to model the capacity requirements for its statewide public safety wireless communications system. The approach taken here is most likely one of the most thorough, accurate, and advanced approaches to modeling traffic distributions and determining statewide public safety capacity requirements that have been applied to date.

Traffic and User Models



SWN Will Support:

- Multiple Agencies and a Large User Base***
- A Large Number of Talk Groups***
- Point-to-Point and Multicast Mobile Communications***
- Voice and Data Operations***

SWN Traffic Modeling

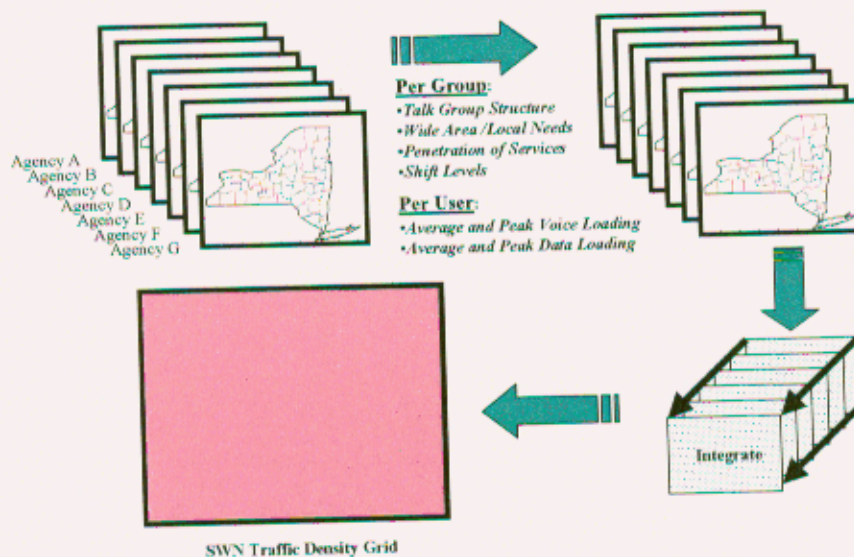
Local Traffic

- Uses "User" and "Traffic" density grids.
- Based upon users within the area captured by a given coverage contour.
- Users are then converted, group by group, to radio traffic
- This drives channel requirements

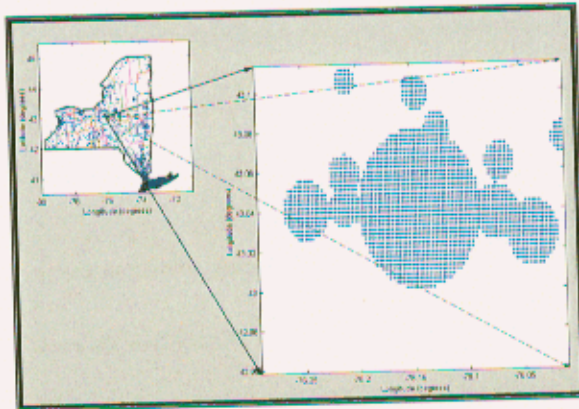
Wide Area Traffic

- Uses county level talkgroup loading
- Based upon users in all counties with any area captured by a given coverage contour.
- Users are then converted, group by group, to radio traffic
- This drives channel requirements

Traffic Grid Concept



Traffic Grid Resolution



- The sample points in the traffic Grid are evenly spaced -every 250 m, in both latitude and longitude ($\sim 42/\text{mi}^2$)

- The average County has 33,000 sample points (range of 400 to 117,000 points).
- The average City or Village has 146 sample points (range of 4 to 13,000 points).

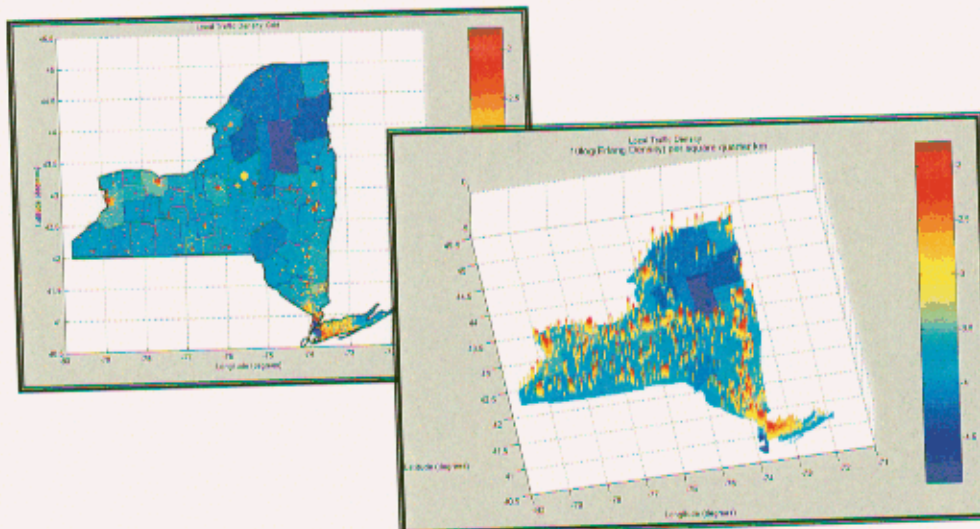
Agency Traffic Parameters

- User populations were translated into traffic loading through the consideration of:
 - Voice and Data Service Penetrations – The expected fraction of user population requiring a particular communications process.
 - Operational Time Schedules – The expected fraction of user population active during the typical busy-hour of the day.
 - Average per Unit/User Loading – The expected per-user traffic loading averaged over the course of a day.
 - Peak per-Unit/User Loading – The expected per-user traffic loading during the busiest one-hour period of a day.
 - Wide Area, Local, and Off-System/Tactical Communications Percentages.
- Determined through user interviews & PSWAC

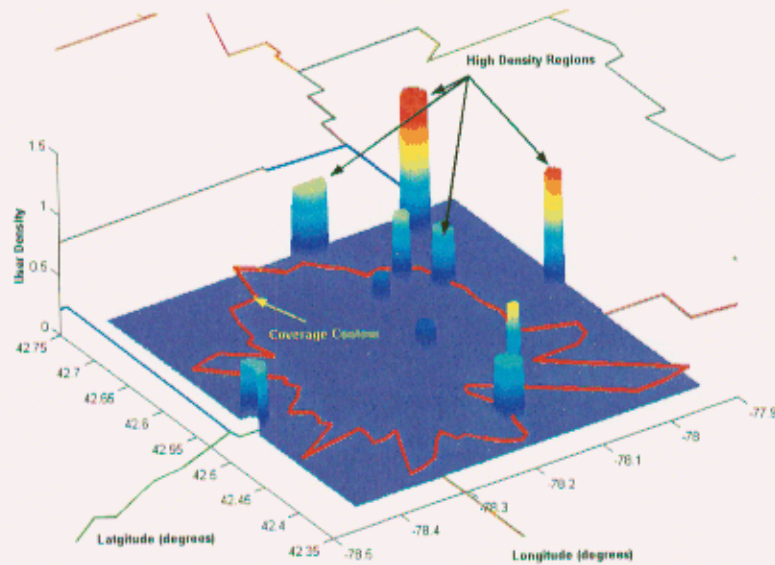
Spectrum Requirements

- **Site Capacity**
 - Uses the coverage contours to “capture” traffic from the density grid
 - Integrates this “local traffic” with the wide-area communications traffic of the captured user groups
 - To handle local and wide-area communications
- **Site Channel Requirements**
 - Using Erlang-C, the site capacity translates to site channel requirements
 - Similar methodologies were recommended by PSWAC
- **Total Spectrum Required for SWN**
 - Function of both the total site channel requirements, and the effective frequency reuse of system

Local Traffic Density from Aggregate Grid



Coverage Contour Traffic Capture (Example, Fire)



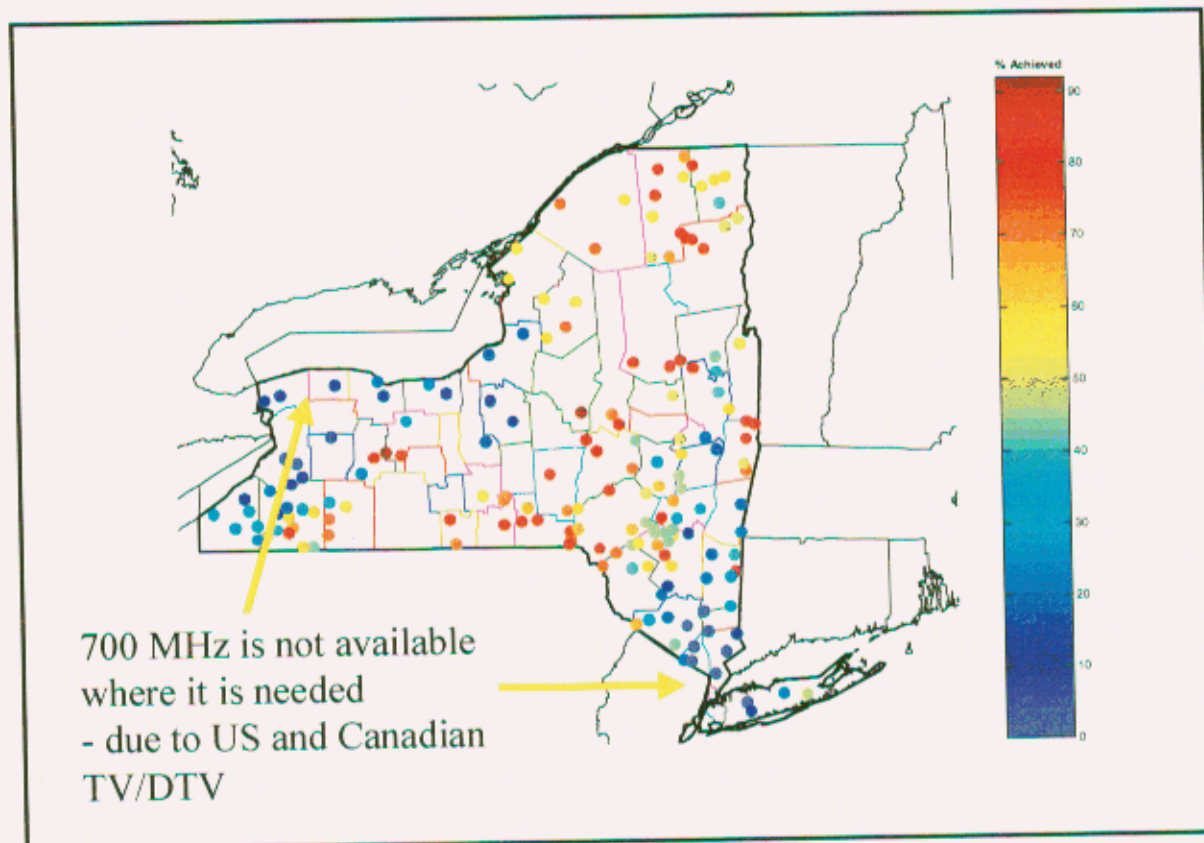


Figure J-1: Areas where 800 MHz Spectrum Does Not Meet SWN Capacity Estimates

Figure J-1 shows the geographic percentage of SWN capacity that can be met through available 800 MHz public safety spectrum. Clearly 700 MHz is not available where it is needed most.

K. OUT-OF-BAND EMISSIONS (OOBES)

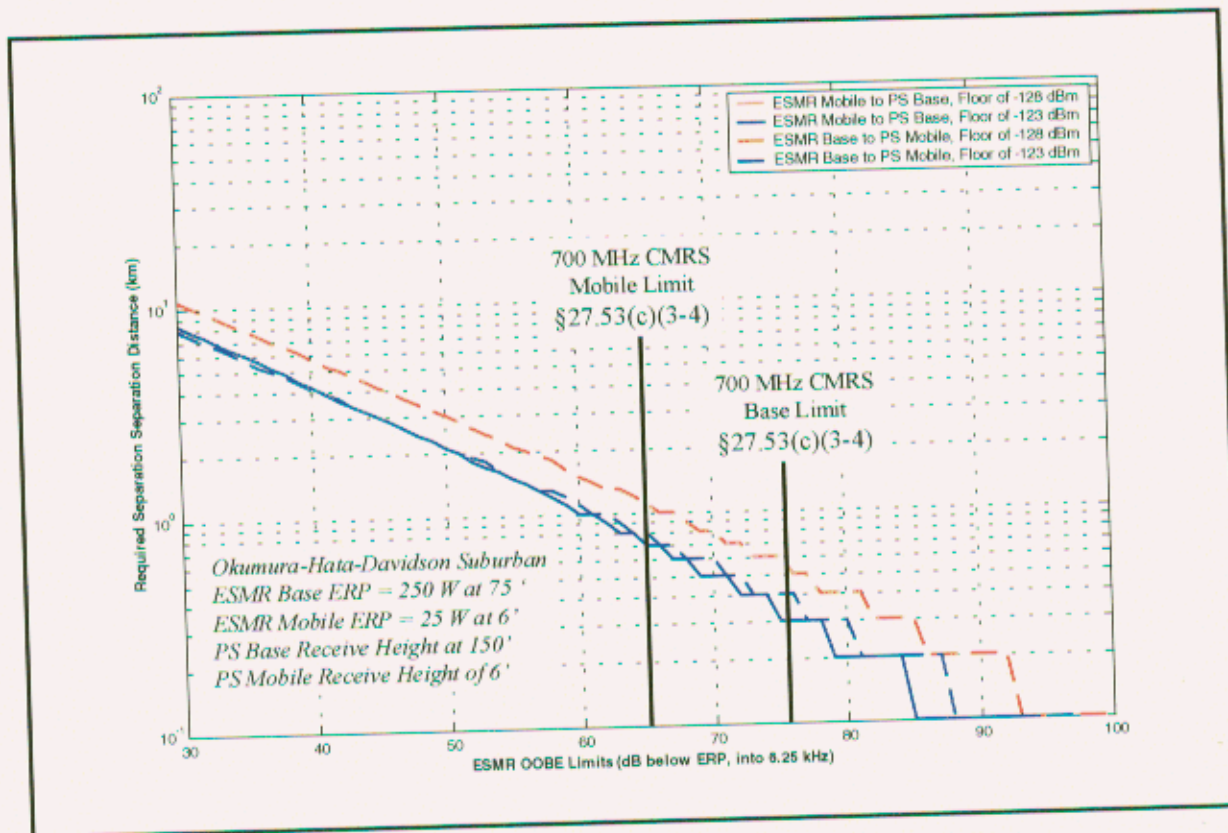


Figure K-1: Public Safety/ESMR Separation vs. Out-of-Band Emissions

Figure K-1 represents the separation distance versus ESMR OOB requirements (into 6.25 kHz), as adopted in the Commercial 700 Hz spectrum allocation¹. The separation distances are evaluated for both ESMR mobile to PS base, and ESMR base to PS mobile. Separations are also considered at cases of Public safety sensitivity degradation corresponding to thermal noise levels of -123 and -128 dB ($ENBW = 10$ kHz, $N_f = 6$ dB, and 11 dB respectively). It is evident that these levels represent what should be a minimum recommendation for the OOB.

¹ §27.53(c-3,4)

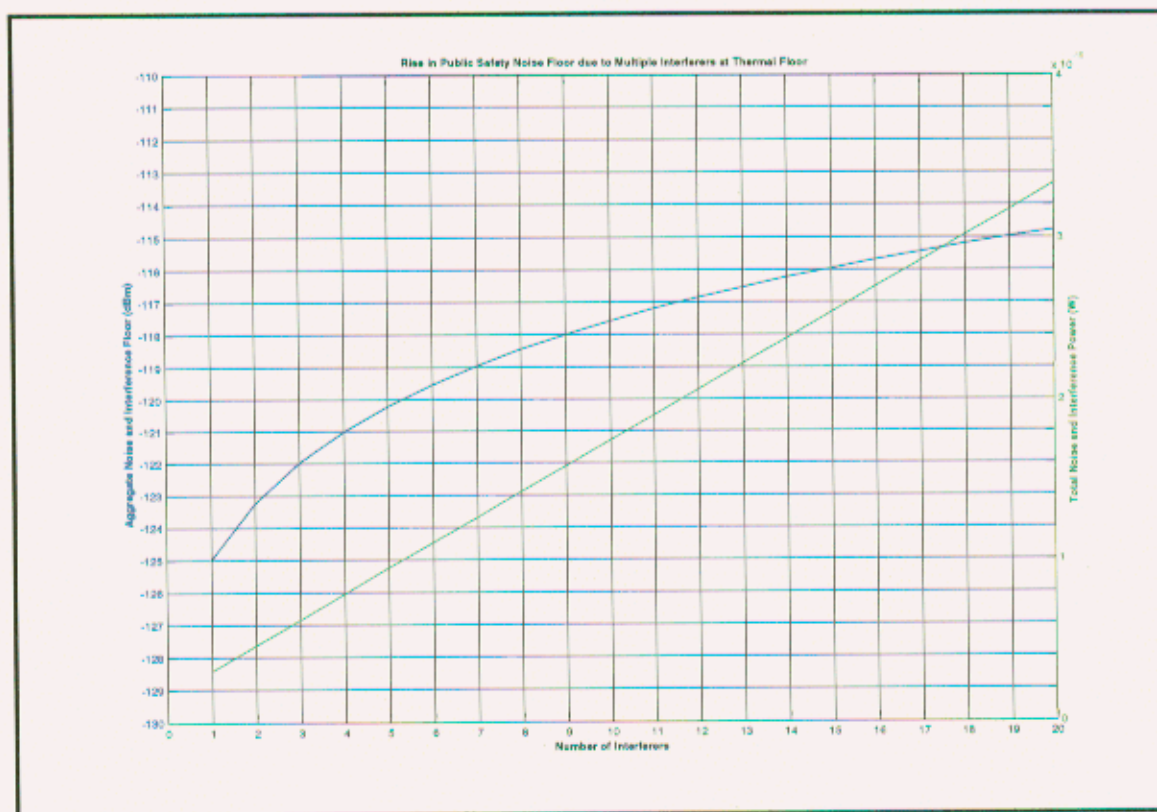


Figure K-2: Rise in Public Safety Noise Floor due to Multiple CMRS Interferers

Figure K-2 represents the rise in the noise and interference floor (corresponding to a loss in sensitivity) versus the number of Commercial Mobile Radio Service (CMRS²) interferers. Each interferer is assumed to be at the same level (in-band) as the public safety thermal noise floor ($k \cdot T \cdot B \cdot N_f$). In this case, the Public Safety thermal noise floor was set to -128 dBm ($ENBW = 10$ kHz, $N_f = 6$ dB), but the effect is clearly scalable to other values. It is also evident that multiple interferers dramatically reduce the sensitivity (hence coverage reliability) of Public Safety.

² A category under which ESMR services would fall.